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U.S. Is Losing Its Dominance in the Sciences

By **WILLIAM J. BROAD**

Published: May 3, 2004

The United States has started to lose its worldwide dominance in critical areas of science and innovation, according to federal and private experts who point to strong evidence like prizes awarded to Americans and the number of papers in major professional journals.

Foreign advances in basic science now often rival or even exceed America's, apparently with little public awareness of the trend or its implications for jobs, industry, national security or the vigor of the nation's intellectual and cultural life.

"The rest of the world is catching up," said John E. Jankowski, a senior analyst at the National Science Foundation, the federal agency that tracks science trends. "Science excellence is no longer the domain of just the U.S."

Even analysts worried by the trend concede that an expansion of the world's brain trust, with new approaches, could invigorate the fight against disease, develop new sources of energy and wrestle with knotty environmental problems. But profits from the breakthroughs are likely to stay overseas, and this country will face competition for things like hiring scientific talent and getting space to showcase its work in top journals.

One area of international competition involves patents. Americans still win large numbers of them, but the percentage is falling as foreigners, especially Asians, have become more active and in some fields have seized the innovation lead. The United States' share of its own industrial patents has fallen steadily over the decades and now stands at 52 percent.

A more concrete decline can be seen in published research. Physical Review, a series of top physics journals, recently tracked a reversal in which American papers, in two decades, fell from the most to a minority. Last year the total was just 29 percent, down from 61 percent in 1983.

China, said Martin Blume, the journals' editor, has surged ahead by submitting more than 1,000 papers a year. "Other scientific publishers are seeing the same kind of thing," he added.

Another downturn centers on the Nobel Prizes, an icon of scientific excellence. Traditionally, the United States, powered by heavy federal investments in basic research, the kind that pursues fundamental questions of nature, dominated the awards.

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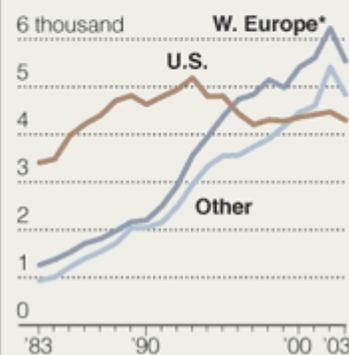



Overtaking the U.S.

In Physical Review, articles by physicists in other countries now outnumber those by U.S. scientists.

ARTICLES PUBLISHED

By writer's country of origin



* Twenty countries in Europe

Sources: The American Physical Society

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But the American share, after peaking from the 1960's through the 1990's, has fallen in the 2000's to about half, 51 percent. The rest went to Britain, Japan, Russia, Germany, Sweden, Switzerland and New Zealand.

"We are in a new world, and it's increasingly going to be dominated by countries other than the United States," Denis Simon, dean of management and technology at the Rensselaer Polytechnic Institute, recently said at a scientific meeting in Washington.

Europe and Asia are ascendant, analysts say, even if their achievements go unnoticed in the United States. In March, for example, European scientists announced that one of their planetary probes had detected methane in the atmosphere of Mars — a possible sign that alien microbes live beneath the planet's surface. The finding made headlines from Paris to Melbourne. But most Americans, bombarded with images from America's own rovers successfully exploring the red planet, missed the foreign news.

More aggressively, Europe is seeking to dominate particle physics by building the world's most powerful atom smasher, set for its debut in 2007. Its circular tunnel is 17 miles around.

Science analysts say Asia's push for excellence promises to be even more challenging.

"It's unbelievable," Diana Hicks, chairwoman of the school of public policy at the Georgia Institute of Technology, said of Asia's growth in science and technical innovation. "It's amazing to see these output numbers of papers and patents going up so fast."

Analysts say comparative American declines are an inevitable result of rising standards of living around the globe.

"It's all in the ebb and flow of globalization," said Jack Fritz, a senior officer at the National Academy of Engineering, an advisory body to the federal government. He called the declines "the next big thing we will have to adjust to."

The rapidly changing American status has not gone unnoticed by politicians, with Democrats on the attack and the White House on the defensive.

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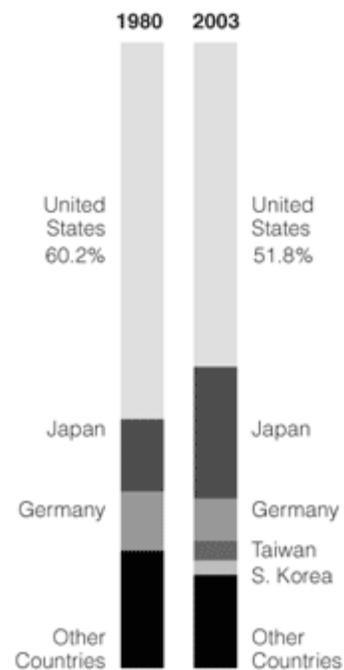
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Tracking Achievement

Indicators show that the United States is losing its lead in scientific achievement.

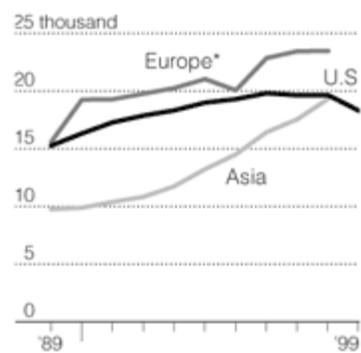
Patents

Granted by the U.S., by country of inventor.



Doctoral Degrees

In science and engineering, in the top three regions (1999 data was not available for Asia and Europe*).



*Britain, Germany and France

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"We stand at a pivotal moment," Tom Daschle, the Senate Democratic leader, recently said at a policy forum in Washington at the American Association for the Advancement of Science, the nation's top general science group. "For all our past successes, there are disturbing signs that America's dominant position in the scientific world is being shaken."

Mr. Daschle accused the Bush administration of weakening the nation's science base by failing to provide enough money for cutting-edge research.

The president's science adviser, John H. Marburger III, who attended the forum, strongly denied that charge, saying in an interview that overall research budgets during the Bush administration have soared to record highs and that the science establishment is strong.

"The sky is not falling on science," Dr. Marburger said. "Maybe there are some clouds — no, things that need attention." Any problems, he added, are within the power of the United States to deal with in a way that maintains the vitality of the research enterprise.

Analysts say Mr. Daschle and Dr. Marburger can both supply data that supports their positions.

A major question, they add, is whether big spending automatically translates into big rewards, as it did in the past. During the cold war, the government pumped more than \$1 trillion into research, with a wealth of benefits including lasers, longer life expectancies, men on the Moon and the prestige of many Nobel Prizes.

Today, federal research budgets are still at record highs; this year more than \$126 billion has been allocated to research. Moreover, American industry makes extensive use of federal research in producing its innovations and adds its own vast sums of money, the combination dwarfing that of any other nation or bloc.

But the edifice is less formidable than it seems, in part because of the nation's costly and unique military role. This year, financing for military research hit \$66 billion, higher in fixed dollars than in the cold war and far higher than in any other country.

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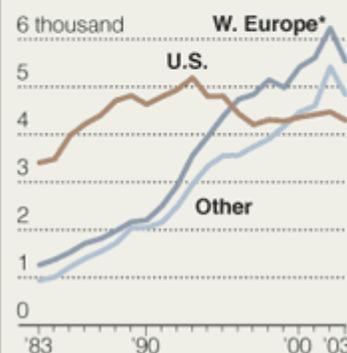



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For all the spending, the United States began to experience a number of scientific declines in the 1990's, boom years for the nation's overall economy.

For instance, scientific papers by Americans peaked in 1992 and then fell roughly 10 percent, the National Science Foundation reports. Why? Many analysts point to rising foreign competition, as does the European Commission, which also monitors global science trends. In a study last year, the commission said Europe surpassed the United States in the mid-1990's as the world's largest producer of scientific literature.

Dr. Hicks of Georgia Tech said that American scientists, when top journals reject their papers, usually have no idea that rising foreign competition may be to blame.

On another front, the numbers of new doctorates in the sciences peaked in 1998 and then fell 5 percent the next year, a loss of more than 1,300 new scientists, according to the foundation.

A minor exodus also hit one of the hidden strengths of American science: vast ranks of bright foreigners. In a significant shift of demographics, they began to leave in what experts call a reverse brain drain. After peaking in the mid-1990's, the number of doctoral students from China, India and Taiwan with plans to stay in the United States began to fall by the hundreds, according to the foundation.

These declines are important, analysts say, because new scientific knowledge is an engine of the American economy and technical innovation, its influence evident in everything from potent drugs to fast computer chips.

Patents are a main way that companies and inventors reap commercial rewards from their ideas and stay competitive in the marketplace while improving the lives of millions.

Foreigners outside the United States are playing an increasingly important role in these expressions of industrial creativity. In a recent study, CHI Research, a consulting firm in Haddon Heights, N.J., found that researchers in Japan, Taiwan and South Korea now account for more than a quarter of all United States industrial patents awarded each year, generating revenue for their own countries and limiting it in the United States.

Moreover, their growth rates are rapid. Between 1980 and 2003, South Korea went from 0 to 2 percent of the total, Taiwan from 0 to 3 percent and Japan from 12 to 21 percent.

"It's not just lots of patents," Francis Narin, CHI's president, said of the Asian rise. "It's lots of good patents that have a high impact," as measured by how often subsequent patents cite them.

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Recently, Dr. Narin added, both Taiwan and Singapore surged ahead of the United States in the overall number of citations. Singapore's patents include ones in chemicals, semiconductors, electronics and industrial tools.

China represents the next wave, experts agree, its scientific rise still too fresh to show up in most statistics but already apparent. Dr. Simon of Rensselaer said that about 400 foreign companies had recently set up research centers in China, with General Electric, for instance, doing important work there on medical scanners, which means fewer skilled jobs in America.

Ross Ambrecht, president of the Industrial Research Institute, a nonprofit group in Washington that represents large American companies, said businesses were going to China not just because of low costs but to take advantage of China's growing scientific excellence.

"It's frightening," Dr. Ambrecht said. "But you've got to go where the horses are." An eventual danger, he added, is the slow loss of intellectual property as local professionals start their own businesses with what they have learned from American companies.

For the United States, future trends look challenging, many analysts say.

In a report last month, the American Association for the Advancement of Science said the Bush administration, to live up to its pledge to halve the nation's budget deficit in the next five years, would cut research financing at 21 of 24 federal agencies — all those that do or finance science except those involved in space and national and domestic security.

More troubling to some experts is the likelihood of an accelerating loss of quality scientists. Applications from foreign graduate students to research universities are down by a quarter, experts say, partly because of the federal government's tightening of visas after the 2001 terrorist attacks.

Shirley Ann Jackson, president of the American Association for the Advancement of Science, told the recent forum audience that the drop in foreign students, the apparently declining interest of young Americans in science careers and the aging of the technical work force were, taken together, a perilous

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combination of developments.

"Who," she asked, "will do the science of this millennium?"

Several private groups, including the Council on Competitiveness, an organization in Washington that seeks policies to promote industrial vigor, have begun to agitate for wide debate and action.

"Many other countries have realized that science and technology are key to economic growth and prosperity," said Jennifer Bond, the council's vice president for international affairs. "They're catching up to us," she said, warning Americans not to "rest on our laurels."

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